Is This Really Okay for Me?
A Public Health Statistical Analysis

Mark Wathen

Manti High School, Manti, Utah

In collaboration with Owen Devine, National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention

In this lesson, students will model the use of the public health framework to determine the effects of a fictitious drug. This modeling will include the design of a simulated analysis, including the collection and interpretation of student-generated data. Students will evaluate, present, and defend the results of their groups' study. This lesson plan will connect ratios with concrete examples in the field of public health.

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Summary
Students will model the use of the public health framework to determine the effects of a fictitious drug. This modeling will include the design of a simulated analysis, including the collection and interpretation of student-generated data. Students will evaluate, present, and defend the results of their groups' study. If necessary, review ratios prior to beginning the lesson. Students should be competent in the use of fractions and ratios. This lesson plan will connect ratios with concrete examples in the field of public health.

Learning Outcomes
- Students will be able to collect and analyze data obtained from a simulated public health model.
- Students will be able to calculate, by using ratios, prevalence, incidence, and risk.
- Students will be able to provide statistical evidence and defend a conclusion.

Materials
1. Paper bags (lunch bag size)
2. Pinto beans (10 pounds)
3. Paper or plastic cups (9 ounces)
4. Red spray paint
5. Newspaper
6. Calculators

Total Duration
3 hours, 20 minutes

Procedures

Teacher Preparation
The teacher will download the PowerPoint presentation and review the notes for each slide prior to teaching the class. The teacher will print copies of the student letter that introduces the investigation and print copies of the student guidelines for the student investigation. The teacher will then download and print the assessment material found under the conclusion and review the assessment rubric. The teacher should also become familiar with the Role, Audience, Format, Topic (R.A.F.T.) guidelines (see "R.A.F.T. Assignment – Teacher Guide").

The teacher will prepare the models for the investigation and following the teacher investigation guidelines (see "Roplex Investigation Teachers Guide"), produce the simulated populations.

Supplemental Documents
Title: Roplex Investigation Teacher Guide.
File Name: Teacher Guide.
Description: Describes epidemiology activities for the lesson.

Introduction **Duration: 50 minutes**

Introduction to the lesson:
The teacher will introduce the lesson by defining "public health" as "the science and art of preventing disease, prolonging life and promoting health through the organized efforts of society."

- Public health looks at a population as a whole not at the individual person; this is a difference between the public health field and the medical field.
- To prevent disease from spreading and to keep communities healthy, researchers keep track of and monitor diseases.
- The PowerPoint presentation will go more in-depth about public health and the basics of epidemiology.

The students will view the PowerPoint presentation and discuss the example used in the presentation. The teacher will then model the sample calculations of prevalence, incidence, and risk ratio. Students will need to be able to perform these calculations on their own as part of the student investigation.

After the students view the PowerPoint presentation, the teacher will then give the students a letter outlining the following fictitious scenario: A new drug has entered the marketplace. This new drug was designed to help alleviate some of the symptoms of allergies and was found to do so in clinical trials. There are some concerns now that there is a side effect of the drug. Physicians from around the country are reporting that birth defects are on the rise. The teacher will ask the students to share with a person sitting next to them the role that public health will play in this situation.

If students do not understand what clinical trials are, the teacher will explain that the National Institutes of Health defines clinical trials as scientific studies of how a new medicine or treatment works in people. Through clinical studies, doctors find new and better ways to prevent, detect, diagnose, control, and treat illnesses. If students want more information about clinical trials the teacher should suggest students visit the following website:
http://clinicalstudies.info.nih.gov/what_is_study.html

Supplemental Document
Title: Student Letter.
File Name: Student Letter.
Description: Introduces the investigation into the fictitious drug.

Step 2 **Duration: 50 minutes**

Activity-Day 1
The teacher will introduce the Roplex Investigation, and provide the students with the Roplex Investigation handout. Students will work in pairs or small groups to complete the activity for Day 1. The teacher will provide each group of students with a bag of beans; each bag should have the same number of beans to have the average prevalence be the correct value, approximately 300 grams of beans per bag. This bag will need to represent a population with about 3% birth defects (similar to the rate seen in the national population). Those beans representing a birth defect will be labeled with a red dot. Each group of students will count the number of birth defects and the total population in the sample. Each group will calculate the prevalence of birth defects in its population and report it to the rest of the class. This report will be a simple oral presentation in which the students will share and compare the information that they calculated with the rest of the class. The teacher will record the prevalence value for each group and calculate the average for the class.

Web Resources

Title: Basic Facts about Birth Defects.
URL: http://www.cdc.gov/ncbddd/bd/facts.htm
Description: This site answers frequently asked questions regarding birth defects.

Title: ERIC Notebook, June 1999, Issue 2.
URL: http://hsrd.durham.med.va.gov/eric/notebook/ERICIssue02.pdf
Description: Provides definitions of incidence and prevalence along with explanation of calculations. Also provides a self-evaluation of incidence and prevalence.

Title: Epidemiology in Action.
URL: http://www.collegeboard.com/prod_downloads/yes/holmstrom_slides_unit_3.ppt
Description: PowerPoint presentation of epidemiology in action. Includes examples of prevalence and incidence calculations.

Supplemental Document

Title: Roplex Investigation.
File Name: Roplex Investigation
Description: Student activity that models collection of analysis of data in a public health setting.

Step 3 **Duration: 50 minutes**

Activity—Day 2

Now that students have practiced calculating prevalence, the teacher will give each group of students a new sample population (bag of beans) and have them complete the Day 2 portion of the Roplex Investigation. These sample populations will represent women who were exposed to the new drug. Students will calculate the incidence and risk ratio of these populations. There will be two possible outcomes for each population—one that represents a positive effect (lower rates in birth defects) and one that represents a negative effect (higher rates in birth defects). Depending on their results, each group of students will need to decide what effect was present in their investigation.

Conclusion **Duration: 50 minutes**

The design, synthesis, and testing that pharmaceutical companies must go through before a drug is introduced to the public is a long process. Once the drug reaches the marketplace, its side effects must be evaluated. This lesson will investigate how a public health professional might look at the effects of a new drug on birth defects. Data will be collected and analyzed in terms of prevalence. Finally, one of the most important parts in any type of research is the dissemination of the information. Each group of students will present and defend their findings to the rest of the class. Finally, the groups will further evaluate their results by writing a R.A.F.T. essay on their respective findings.

Web Resource

Title: Having a Healthy Baby.
URL: http://www.cdc.gov/ncbddd/bd/abc.htm
Description: This site is an ABC guide to having a healthy baby. Also included is a section regarding the risks in using medications and alcohol during pregnancy.

Title: R.A.F.T. description
URL: http://curry.edschool.virginia.edu/go/readquest/strat/raft.html
Description: This site provides descriptions of RAFT assignments.

Title: R.A.F.T. example.
URL: http://curry.edschool.virginia.edu/go/readquest/strat/raft.html
Description: This site provides an example of a R.A.F.T. essay.

Title: R.A.F.T.: Role, Audience, Format, and Topic
URL: http://literacy.kent.edu/eureka/strategies/raft.pdf
Description: Provides a brief introduction for R.A.F.T. format.

Supplemental Documents
Title: Roplex Investigation Presentation Rubric.
File Name: Roplex Investigation Presentation Rubric.
Description: Outline of presentation rubric for students and instructor.

Title: R.A.F.T. Assignment – Teacher Guide
File Name: R.A.F.T. assignment teacher
Description: Outline of R.A.F.T. assignment including classroom instruction and rubric.

Title: R.A.F.T. Assignment – Student Guide
File Name: R.A.F.T. assignment student
Description: Description of the R.A.F.T. assignment for students. Includes brief discussion about a R.A.F.T. and provides a grading rubric for the students.

Title: R.A.F.T. Rubric
File Name: R.A.F.T. Rubric
Description: A guide how to assess students' work based on R.A.F.T. instructions.

Assessment

The students will be assessed throughout the investigation by responding to questions posed by the teacher and by presenting data to support their conclusions. At the end of the lesson the students writing sample will be assessed by using the RAFT method.

Modifications

Extension(s)
This project may be combined with a statistics class to calculate the t-statistic of two sample populations. This calculation might be too extensive for every chemistry class, but would provide an excellent opportunity to collaborate with a statistics teacher. The teacher should consult with the statistics teacher in their school to help in developing this extension.

Web Resource
Title: Introduction to the T-Statistic.
URL:http://artsandscience.concordia.ca/psyc31502/pdf_word_excel/lecture09/1sample_ttest_4page.pdf
Description: A step-by-step guideline through the calculation of the t-statistic from Concordia University.

Education Standards

National Science Education Standards
SCIENCE AS INQUIRY, CONTENT STANDARD A:
As a result of activities in grades 9–12, all students should develop

- **Abilities necessary to do scientific inquiry.**
- **Understandings about scientific inquiry .**

SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES, CONTENT STANDARD F:
As a result of activities in grades 9–12, all students should develop understanding of

- **Personal and community health**
- Population growth
- Natural resources
- Environmental quality
- **Natural and human-induced hazards**
- Science and technology in local, national, and global challenges

PHC
Public Health Consultation

Roplex Investigation-Student Letter

(Insert current date)

Dear Consultants,

We need your help to implement an investigation of a new drug that has recently entered the market. This new drug, Roplex, was originally designed to help reduce some of the symptoms of allergies, like itchy eyes, runny nose, and sneezing. It has successfully done so in clinical studies. Now, there are some concerns that major side effects might occur as a result of taking this drug. Women of child bearing age and women who are pregnant are most at risk. Several physicians from around the country are reporting that birth defects are on the rise.

You will need to use your expertise in public health to determine if Roplex is a factor in this increase in these birth defects. To accomplish this task, you will need to conduct analyses to determine the effects of this drug. The first piece of this analysis will need to focus on the data collected by the physicians over the last couple of months. This monitoring of diseases or health-related conditions is referred to as surveillance. As part of your analysis of the surveillance data you will need to identify the population affected, the time period during which the data were collected, and where the data were collected.

The second part of your analysis will need to include data-driven evidence that focuses on identifying and quantifying any association between Roplex and the birth defects reported. These epidemiological calculations will help you determine whether there is an association with Roplex and higher rates of these birth defects.

After you have your findings you will make a recommendation regarding your findings. Communication of your ideas and findings are critical to fulfillment of the public health mission.

Thank you for your help in this matter. We look forward to seeing your results.

Insert Name

President PHC

Disclaimer: This is a fictitious scenario, and the drug, Roplex, does not exist. All data has been simulated for the purpose of the investigation.

Insert School Name
Insert Address
1234 Any Street
Townsville, State 54321

PHC
Public Health Consultation

Roplex Investigation–Teacher Guide

Is This Really Okay For Me? A Public Health Statistical Analysis
Mark Wathen, CDC's 2005 Science Ambassador Program

Materials

1. Minimum of 30 paper bags (lunch bag size)
2. Pinto Beans (20 pounds)
3. Minimum of 30 paper or plastic cups (9 ounces)
4. 1 can of red spray paint.

I. Set–up

This investigation is designed to take place over two 50-minute class periods. The set–up is for 30 students working in pairs.

II. Prior to Day of Investigation

The teacher will split the 20 pounds of pinto beans into two 10 pound portions.

Portion One

After splitting the twenty pounds of pinto beans into two 10 pound portions, the teacher will take the first 10 pound portion and weigh out 135grams of beans, laying them one layer thick over newspaper. The teacher will spray paint these beans red and then let dry. When the beans are dry, they should be added back to the first portion and mixed. This mixture will represent a total population that has a prevalence of about 3 out of 100 or 3% birth defects. This value represents national data for birth defects.

The teacher should divide this mixture into 15 equal amounts (approximately 300grams each) and place them into 15 paper bags. On day one these bags will represent the total population. On day two, these bags will be used to represent the population of mothers not exposed to Roplex. Be sure to label these bags with the words "Total Population".

Portion Two

Using the second 10 pound portion of beans, the teacher will, divide them into 15 equal amounts (approximately 300grams each) and place them into paper bags labeled Roplex exposure. These labels will be labeled from 1 to 15. For bags 1, 5, 9, and 13, the teacher will remove 3 grams of beans from each bag and lay one layer thick on a sheet of newspaper. The teacher must keep each group of 3 grams separated from the others. The teacher will spray paint these beans, let them dry, and return three grams to each bag. These bags will represent populations with a prevalence of 1 out of 100 (or 1%) birth defects. These populations will show a prevalence ratio of less than one, indicating that Roplex is actually inhibiting birth defects.

For the remainder of the bags, the teacher will weigh out thirty grams each and mark the beans with red paint using the same procedure as described in Portion One, then return them to the bags. These bags will represent a population with a prevalence of 10 out of 100 (or 10%) birth defects. These populations will have a prevalence ratio of greater than one, indicating that Roplex is producing the outcome.

Investigation Day One

The teacher should encourage students to be careful when collecting and counting their populations. Beans tend to spill easily. The more accurately students count and keep track of their beans, the more effective the results. Organization is also important in this activity. Students also should be encouraged to keep track of their beans, record the label of their bag, and keep their data in a special location. The teacher should make sure that students are recording their results and storing their data properly throughout the investigation.

Throughout the investigation, the teacher should encourage the students to brainstorm alternative experimental designs and to extend their work beyond the specific items requested.

The following is an answer guide to the questions asked of the students during the investigation.

Day 1:
Answer the following questions on a separate piece of paper.

1. Taking all of your sampling into consideration, if you had to give an official estimate of the percentage of birth defects in the general population, what would it be? Justify your reasoning.
   (Answers might vary). Based on the prevalence I found in the general population sample, the prevalence of birth defects is 3%. I didn't include the prevalence I found in the investigation sample because the prevalence may be different from the general population.

2. Compare your data with those of the rest of the class.
   a. How close were your estimates to those of the class?
      (Answers might vary).
   b. How would you account for the difference between your estimates and the other class estimates of birth defects?
      (Answers might vary, give full credit to the answers that give logical explanation of the difference in estimates e.g., math errors, random chance).

3. How many samples do you think give the best results? Why?
   In general a larger number of samples should give an estimate closer to the true value of the prevalence in the population.

4. What are the strengths and weaknesses in collecting birth defect data in this way?
   (Answers might vary). By calculating the prevalence for samples the prevalence of the entire population may be different because it is not being measured. This method is quicker and more practical but may not reflect the true prevalence in the population.

5. How else could you collect data on birth defects?
   (Answers might vary). You could interview mother and baby as they leave the hospital, you could review birth certificates or talk to physicians.

Day 2:

Sample calculation:

	Defect	No Defect	Total
Exposure	20	50	70
Unexposure	10	30	40
Total	30	80	110

(Prevalence Ratio) PR calculation= 20/70 / 10/40 = 0.2857/.025 =1.1428

Add statement describing results.

According to my calculations, the prevalence of birth defects when a mother takes Roplex is 1.1428 times higher than when a mother does not take Roplex.

PHC
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Roplex Investigation–Student Handout

Is This Really Okay For Me? A Public Health Statistical Analysis
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You have been asked to help epidemiologists determine if a new drug, Roplex, is a factor in an increase in birth defects across the country. An epidemiologist is someone who studies the transmission and control of epidemic diseases. Counting each birth defect across the entire country would be a monumental task. Typically, epidemiologists determine the number of birth defects by sampling smaller populations and then using ratios to relate the data that they collect to the total population.

In this investigation, you will work in pairs to help to determine whether or not Roplex is causing a change in the rate of birth defects. You will be given two populations; one that represents recent births of children whose mothers were exposed to Roplex and one group whose mothers were not exposed. The lunch bag will represent the total population and the beans will represent newborn children. Some of the beans will be red, representing children who are born with birth defects.

I. Day One

Today you will determine the prevalence of birth defects in the total population.

Procedure

1. Use your paper cup and obtain a sample from the total population (paper bag) of the unexposed.
2. Count the number of beans that represent children with birth defects (red beans) and children born without birth defects.
3. Add your calculations to the Roplex Investigation data table.
4. Return all of your beans back into the paper bag.
5. Take another sample from the total population and repeat the preceding steps.
6. Continue until you have three data sets.

Calculations

1. Determine the prevalence of birth defects by dividing the number of birth defects by the total population.

$$\text{Prevalence} = \frac{\text{Number of those with birth defects}}{\text{Total population}}$$

2. Complete this process for each data set.
3. Find an average percentage.
4. Report your findings to the class.

Samples	Prevalence Calculations
1.	
2.	
3.	

Answer the following questions on a separate piece of paper.

1. Taking all of your sampling into consideration, if you had to give an official estimate of the percentage of birth defects, what would it be? Justify your reasoning.

2. Compare your data with those of the class.
    a. How close were your estimates to those of the class?

    b. How would you account for the difference between your estimates and the class estimates of birth defects?

3. How many samples do you think give the best results? Why?

4. What are the strengths and weaknesses in collecting birth defects data in this way?

5. How else could you collect data on birth defects?

II. Day Two

Today, you will determine if there is a correlation between Roplex and birth defects. To do this, you will investigate one population that has been exposed to Roplex and compare it with one that has not been exposed. The ratio will allow you to compare the prevalence of birth defects between these two populations.

Procedure

1. Use your paper cup and obtain a sample from the total population (paper bag) of those **unexposed to Roplex**.
2. Count the number of beans that represent children with birth defects (red beans) and children born without birth defects. Record your data in the following table.

	Defect	No defect	Total
Exposed to Roplex			
Unexposed to Roplex			
Total			

3. Next, use your paper cup and obtain a sample from the total population (paper bag) of those **exposed to Roplex.**
4. Count and record the number of beans that represent children with birth defects and those without.
5. Return all of your beans back to the paper bag.

Calculations

1. Determine the risk ratio using the following formula:

	Defect	No defect	Total
Exposed to Roplex	A	B	A+B
Unexposed to Roplex	C	D	C+D
Total	A+C	B+D	A+B+C+B

$$\text{Prevalence Ratio} = \frac{A/A+B}{C/C+D}$$

Prevalence Ratio calculation:

Prevalence Ratio calculation=

_____=_____

Add statement describing results.

Report

As you recall from the letter you received from PHC Public Health Consultation, the final analysis of your study will be the publication of a recommendation regarding your findings. It is now time to report your finding to the president of PHC. Write a one-page summary on your findings. Be sure to include in your summary your risk ratio calculation and what that calculation represents. Is Roplex producing more birth defects, producing fewer birth defects, or is no difference seen?

Roplex Investigation Presentation Rubric–For Teacher and Students

Is This Really Okay For Me? A Public Health Statistical Analysis
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Rubric for Evaluating Roplex Investigation Presentations

Standard/Benchmark: The student effectively delivers analysis conclusion to the class and evaluates own performance.

Performance Task: The student presents a summary of his or her findings to the class.

Presentation Rubric						
Assignment: Communicate complete information on findings from Roplex investigation with 2 to 3 PowerPoint slides.						
CATEGORY	**4**	**3**	**2**	**1**	**Self-Evaluation**	**Teacher Evaluation**
Quality of Information	Information clearly relates to the main topic. It includes several supporting details or examples, or both.	Information clearly relates to the main topic. It provides 1-2 supporting details or, examples, or both.	Information clearly relates to the main topic. No details or examples are given.	Information has little or nothing to do with the main topic.		
Mechanics	No grammatical, spelling, or punctuation errors.	Almost no grammatical, spelling, or punctuation errors.	A few grammatical, spelling, or punctuation errors.	Many grammatical, spelling, or punctuation errors.		
Creativity	Displays originality, creativity, and thoughtfulness throughout.	Displays originality, creativity, and thoughtfulness at times.	Some attempts at creativity.	Predictable, little creativity.		
Oral Presentation Skills	Ideas are expressed in a clear and organized fashion. It is easy to understand and follow the presentation.	Ideas are expressed in a pretty clear manner, but the organization could be better.	Ideas are somewhat organized, but are not very clear. It takes more than one explanation to figure out what the presentation is about.	The presentation seems to be a collection of unrelated sentences. It is very difficult to understand and follow the presentation.		
Scale: 16-14 = Expert 13-11 = Intermediate 10-8 = Novice 6-4 = Beginner				**Total Points**		

R.A.F.T. Assignment - Teacher Guide

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Role, Audience, Format, and Topic (R.A.F.T.) writing assignments are almost always written from a different viewpoint than that of the student. The students must creatively connect knowledge they have learned with a new situation. The new connection should reinforce the concept, while providing the student with a creative outlet.

Classroom Instruction

Step one: The teacher should explain to the students that all writers must consider various aspects before every writing assignment. Those aspects typically include the role (who they are as a writer), audience (to whom they are writing to), format (what form the writing will take), and topic (what is the subject or point of the piece). The teacher will explain to the students that they will be developing their projects around these four aspects.

Step two: The teacher will display a completed R.A.F.T. example to the students using an overhead projector, and then the teacher and students will discuss the key elements as a class. (It is more effective if a R.A.F.T. is generated by the teacher. An example of a R.A.F.T., is provided at http://curry.edschool.virginia.edu/go/readquest/strat/raft.html).

Step three: The teacher will demonstrate, model, and "think aloud" with the aid of the class to develop another sample R.A.F.T. exercise.

Step four: The teacher will assign students to small groups or pairs and have them brainstorm ideas for writing a R.A.F.T. from the following table. The teacher will provide assistance as needed, but will give the students time to develop their ideas and present them to the class in written and oral form.

Role	Audience	Format	Topic
Fetus	Mother	Complaint letter	Some good advice
Drug	Self	Diary entry	Life: Laboratory bench to pharmacy
Centers for Disease Control and Prevention	General public	Prevention campaign planning document	Effects of new compound
Physician	Expecting mother	Office visit dialogue	Prenatal health care
Chief Executive Officer (CEO) of drug company	Employees	Memorandum	Outcome of birth defects investigation

R.A.F.T. Assignment - Student Guide

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Directions: Writers must consider different view points before every writing assignment. In this writing assignment, write a short essay from the point of view of each of the following five different roles (a fetus, a drug, the Centers for Disease Control and Prevention, a physician, and the Chief Executive Officer of a drug company). Please write a short essay to the audience listed in the specific format and on the specific topic (example, the fetus is writing a complaint letter to his or her mother on 'Some good advice').

Be sure to include information about the results obtained from the Roplex Investigation (Day 2) to support some of the statements.

The writing assignment will be graded on the following items:

1. Quality of information provided (how the information pertains to the topic and provides examples).
2. Grammar (no spelling or grammar mistakes).
3. Creativity (displays originality and thoughtfulness in the writing).
4. Organization and presentation of thoughts (how well were the ideas presented).

Role	Audience	Format	Topic
Fetus	Mother	Complaint letter	Some good advice
Drug	Self	Diary entry	Life: Laboratory bench to pharmacy
Centers for Disease Control and Prevention	General public	Prevention campaign planning document	Effects of new compound
Physician	Expecting mother	Office visit dialogue	Prenatal health care
Chief Executive Officer (CEO) of drug company	Employees	Memo	Outcome of birth defects investigation

R.A.F.T. – Rubric for Teachers

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Rubric for evaluating R.A.F.T. essays.

CATEGORY	4	3	2	1
Quality of Information	Information clearly relates to the main topic. It includes several supporting details or examples, or both.	Information clearly relates to the main topic. It provides 1 or 2 supporting details or examples.	Information clearly relates to the main topic. No details or examples are given.	Information has little or nothing to do with the main topic.
Mechanics	No grammatical, spelling, or punctuation errors.	Almost no grammatical, spelling, or punctuation errors	A few grammatical, spelling, or punctuation errors.	Many grammatical, spelling, or punctuation errors.
Creativity	Displays originality, creativity, and thoughtfulness throughout.	Displays originality, creativity, and thoughtfulness at times.	Some attempts at creativity	Predictable, little creativity.
Letters	Ideas were expressed in a clear and organized fashion. It was easy to figure out what the letter was about.	Ideas were expressed in a pretty clear manner, but the organization could have been better.	Ideas were somewhat organized, but were not very clear. It took more than one reading to figure out what the letter was about.	The letter seemed to be a collection of unrelated sentences. It was very difficult to figure out what the letter was about.